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(54) Abstract Title

Surgical cutting guide for shortening a bone

(57) A surgical cutting guide comprising a guide body defining a pair of guide slots 28 which are spaced apart, means being provided to secure the cutting guide to a bone which is to be shortened. The guide preferably has a concave rear surface (20) for placement on the bone. In use, a surgical saw is received in and guided by the slots while cutting the bone to form a mutually spaced pair of cuts defining a section of the bone which is to be removed. Preferably also provided is a joining plate 2 having holes for receiving joining screws used to join the bone, the spacing of the screw holes in the joining plate being such that the joining screws can be inserted in the same holes in the bone used when securing the guide body, the cut ends of the bone thereby being abutted.

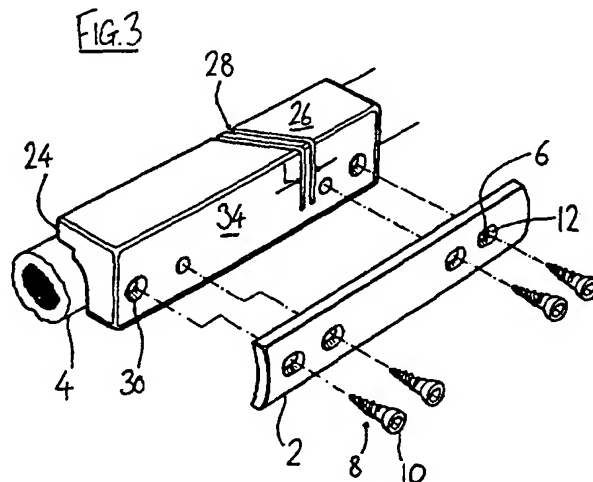


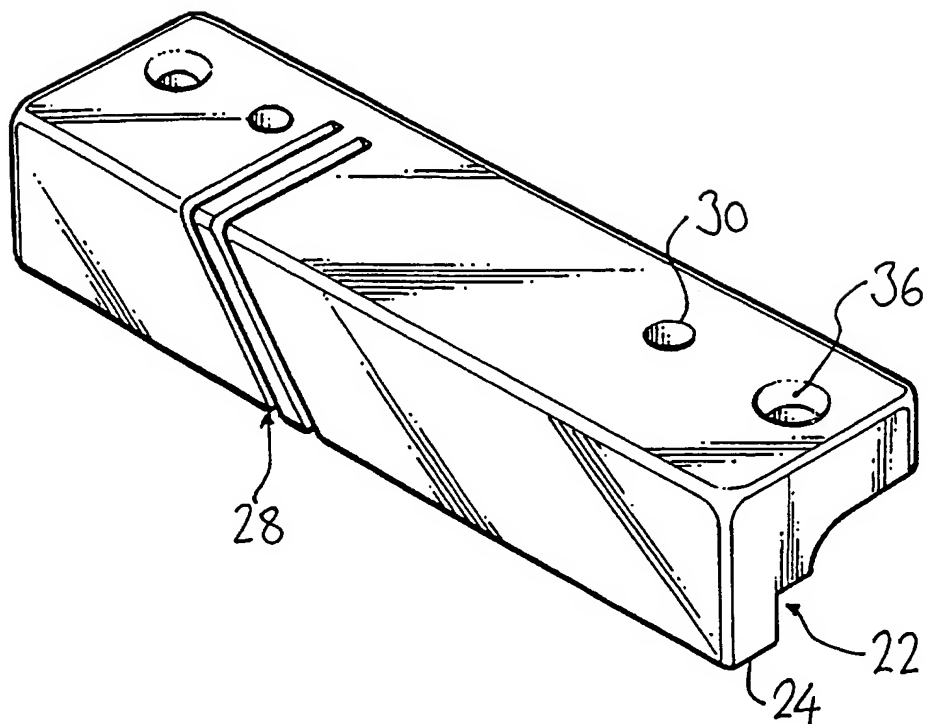
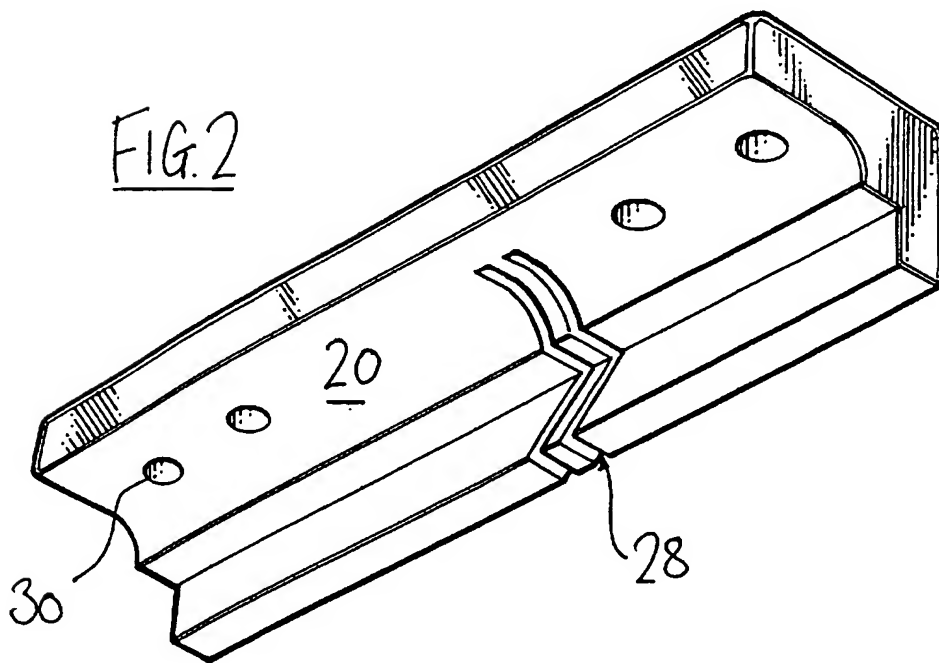
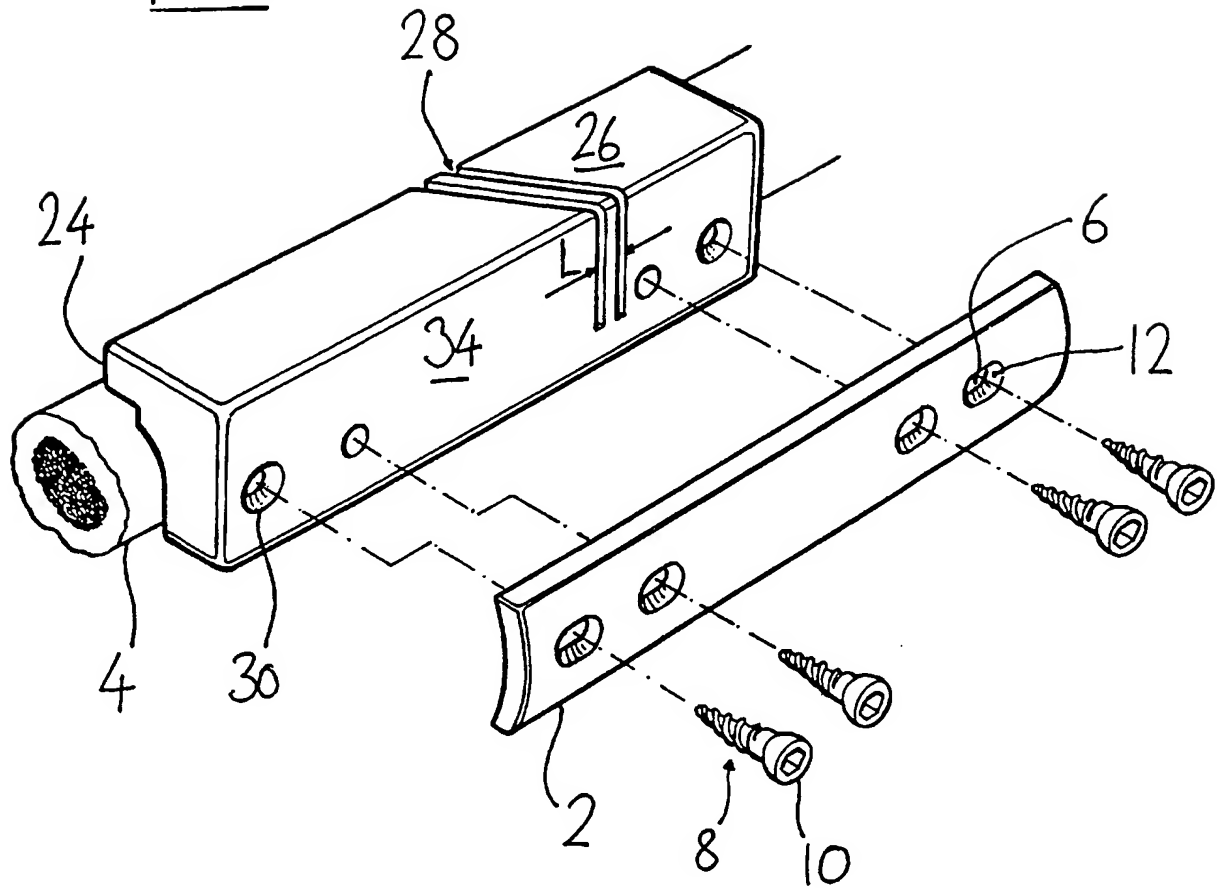
FIG. 1FIG. 2

FIG. 3

-1-

DESCRIPTIONCUTTING GUIDE

The present invention relates to a cutting guide for use in shortening a bone of a human or animal.

Surgical techniques for shortening long bones are well known.

According to the conventional method, the surgeon makes a pair of approximately parallel saw cuts through the bone freehand, the plane of the cuts being approximately perpendicular to the longitudinal axis of the bone. The portion of the bone lying between the two saw cuts is removed, and the cut ends of the remaining two parts of the bone are brought together to produce the required shortening.

A plate such as the one illustrated at 2 in Fig. 3 is used to set the bone. According to the known technique, the surgeon drills and taps (ie forms screw-threads in) holes in the bone 4 corresponding to the locations of slots 6 in the plate. The plate is then screwed to the bone using screws 8 having heads 10 which are conical (ie countersunk). The slots 6 are correspondingly formed with inclined faces.

The surgeon positions the screw holes such that as each screw is screwed into the bone its conical head contacts and moves down the part 12 of the inclined face of a slot which is remote from the cut,

and in so doing draws one part of the bone toward the other, ensuring that where the two parts of the bone meet they are under compression.

Such a procedure is used, for example, in shortening the ulna of a human patient.

One shortcoming of the known procedure is that the accuracy with which the bone is cut and set is dependent on the manual skill of the surgeon. If the cut ends of the bone are not flat, then undesirable gaps will initially be present in the joint. If the bones are misaligned when set using the plate, because of inaccuracies in the positioning of the screw holes and/or because the two saw cuts are not precisely parallel, then the shape of the bone may be distorted.

The procedure described above produces a joint whose plane is roughly perpendicular to the longitudinal axis of the bone, which will be referred to as a "butt joint". An improvement in the joint would be achieved by inclining the plane of the joint - ie by making the two parallel cuts at an angle of, say,  $45^{\circ}$  to the bone axis. The resulting inclined joint would have an increased area of abutment between the two parts of the bone, and provide improvements in strength, circulation, and in rapidity of healing.

Unfortunately, the inaccuracies arising from freehand cutting and setting of the bone have hitherto made it very difficult to successfully form an inclined

joint. The abutting surfaces of the two parts of the bone, having increased length and surface area, need to be cut to a greater degree of accuracy in the inclined joint than in the case of the butt joint. Moreover, a minor inaccuracy in the longitudinal position of one part of the bone relative to the other can cause one bone-part to project laterally relative to the other, adjacent the joint, in a manner which is unacceptable. Rotation of one bone-part relative to the other when the bone is set can cause the bone to be undesirably bowed along its length.

It is an object of the present invention to enable accurate formation of the two cuts through the bone needed in order to shorten it.

It is also desired to enable subsequent accurate setting of the bone.

In accordance with a first aspect of the present invention, there is a cutting guide for use in shortening a bone of a human or animal, comprising a guide body defining a pair of guide slots which are spaced apart, and means for securing the guide body to the bone, such that while the guide body is secured to the bone a cutter can be received in the guide slots and guided thereby while cutting into the bone to form two spaced apart cuts defining a section of the bone which is to be removed.

The cutting guide thus makes it possible to

accurately control the position and orientation of the two cuts into the bone and hence of the section removed. It has been found that the cutting, preferably by means of a saw, can be achieved a great deal more quickly using the guide; operating times have in some instances been halved, with resulting benefits for patients.

The two guide slots are preferably parallel.

The guide body is preferably provided with a surface shaped to substantially conform to the shape of the bone. Such a surface can assist in orienting the guide relative to the bone and in preventing rocking or other movement relative to the bone. The surface may be elongate and have a concave cross section. Such a surface can conveniently rest on the exterior of a long bone, its longitudinal axis being substantially parallel to that of the bone.

The guide slots are preferably parallel sided and of appropriate width to guide a surgical saw. They may be oriented such as to be perpendicular to the bone-axis in use, or (more preferably) inclined to the bone axis.

The means for securing the guide body to the bone most preferably comprise holes disposed on either side of the guide slots for receiving screws to be secured in the bone.

According to a particularly advantageous

embodiment of the present invention, the spacing of the holes is such that following securing of the guide body to the bone using the screws, cutting of the bone, and removal of a section, the bone can be set by means of a plate secured to the bone using screws received in the same holes in the bone used to secure the guide body, the spacing of the holes being such that the cut ends of the bone are brought into contact. Also within the scope of the present invention is a kit of parts comprising a cutting guide and a plate, adapted to be used in this manner.

This has great advantages. Using the known technique it has been necessary to drill the screw holes used for setting the bone after cutting, the positioning of the holes being determined by the surgeon, working freehand. Using the present invention, the screw holes needed to set the bone can be drilled before cutting using the cutting guide to ensure that the holes are accurately positioned. After cutting, the two parts of the bone are automatically aligned and abutted, simply by inserting screws in the existing holes, greatly improving the accuracy with which the bone is set and thereby making possible inclined jointing as described above.

A specific embodiment of the present invention will now be described, by way of example only, with reference to the accompanying figures in



which:-

FIG. 1 is a perspective illustration of a cutting guide constructed in accordance with the present invention, viewed from above;

FIG. 2 is a perspective illustration of the same cutting guide from below; and

FIG. 3 is a perspective illustration of a bone to which the cutting guide is being secured, and of a conventional plate to be used for subsequently setting the bone.

The principal constructional features of the illustrated cutting guide, and its mode of operation, will be apparent from a study of Fig. 3. The guide is machined from surgical steel.

The rear of the cutting guide has a surface 20 whose cross section is a concave curve intended to substantially conform to the cross sectional curvature of the bone 4 to be shortened, so that the guide can be seated against the bone as shown in Fig. 3. The rear of the guide also has, adjacent the curved surface 20, a cutaway 22 (see Fig. 1), formed as a right-angled cutaway, leading to an upper portion 24. When the cutting guide is secured to the bone, the upper portion 24 stands above the bone to receive and guide the saw upon commencement of a cut - see Fig. 3.

The cutting guide has a parallel pair of guide slots 28, which are open at an upper face 26 of

the cutting guide, the width of the slots being appropriate to receive and guide a surgical saw. The guide slots 28 are inclined relative to the longitudinal axis of the cutting guide (in the illustrated embodiment the angle of inclination is  $45^{\circ}$ ) so that the cuts formed in use are at approximately this angle to the longitudinal axis of the bone.

The two guide slots 28 are separated by a distance related to the length of bone to be removed. More specifically, the length of bone removed corresponds to the length marked L in Fig. 3, between respective remote edges of the two slots.

To enable securing of the cutting guide to the bone, the guide is provided with holes 30 which are a clearance fit for screws 32. In the illustrated embodiment, four holes are provided each extending from a front face 34 of the cutting guide to the rear face 20. Two of the holes 30 are positioned to one side of the guide slots 28, the remaining two holes being positioned to the other side of the slots. The positioning of the screw holes 30 is selected to correspond to the positioning of the slots 6 in the plate 2, as will be further explained below.

The sequence of operations when using the cutting guide in shortening a bone is as follows.

Having first exposed the bone, the surgeon drills and taps a first approximately radial hole in

the bone, then attaches the cutting guide to the bone using a first screw 8 extending through one of the holes 30 and into the bone.

Using the cutting guide to locate and guide the drill, the surgeon then drills and taps a second hole in the bone, and inserts a second screw. the first and second screws/holes serve to securely locate the guide, and in order to do so effectively should typically be widely separated. Hence the outermost holes of the guide (ie the holes nearest to the end of the guide) receive the first and second screws. To further assist in securely locating the cutting guide, these outermost holes (and the screws received in them) are countersunk, as Fig. 1 shows at 36.

Holes are then drilled and tapped through the remaining holes 30 in the guide, further screws then being inserted.

A saw, guided in the slots 28, is used to form the two cuts part way through the bone. When using the illustrated guide, the saw reaches the bottom of the slots 28 before passing all of the way through the bone.

The screws, and then the cutting guide, are removed from the bone, and the saw cuts are then completed.

The bone is then set using the plate 2 and screws driven into the same holes used to secure the

cutting guide. It is for this reason that the positioning of holes in the guide is relates to the positioning of holes in the plate. The holes in the guide are positioned such that when the "waste" part of the bone has been removed and the bone is set using the plate, the cut ends of the bone are appropriately abutted. In this way accurate setting of the bone is facilitated.

CLAIMS

1. A surgical cutting guide for use in shortening a bone of a human or animal, comprising a guide body defining a pair of guide slots which are spaced apart, and means for securing the guide body to the bone, such that while the guide body is secured to the bone a cutter can be received in the guide slots and guided thereby while cutting into the bone to form a spaced pair of cuts defining a section of the bone which is to be removed.

2. A surgical cutting guide as claimed in claim 1, wherein the guide slots are parallel.

3. A surgical cutting guide as claimed in claim 1 or claim 2, which comprises a support surface shaped to substantially conform to the shape of the bone.

4. A surgical cutting guide as claimed in claim 3, wherein the support surface is elongate and has a concave cross-section.

5. A surgical cutting guide as claimed in any preceding claim, wherein the guide slots are parallel sided and of appropriate width to guide a surgical saw.

6. A surgical cutting guide as claimed in any preceding claim, wherein the guide slots are oriented such as to be inclined to the bone axis in use.

7. A surgical cutting guide as claimed in any preceding claim, wherein the means for securing the guide body to the bone comprise holes disposed on either side of the guide slots for receiving screws to be secured in the bone.

8. A surgical cutting guide as claimed in claim 7, wherein the spacing of the holes is such that following securing of the guide body to the bone using screws, cutting of the bone, and removal of a section, the bone can be set by means of a plate secured to the bone using screws received in the same holes in the bone used to secure the guide body, the spacing of the holes being such that the cut ends of the bone are brought into contact.

9. A surgical bone shortening apparatus comprising a cutting guide as claimed in claim 7 or claim 8 and a joining plate having holes for receiving bone setting screws, the spacing of the holes being such that following securing of the guide body to the bone using screws, cutting of the bone, and removal of a section, the bone can be set by securing the joining plate to the bone using screws received in the same holes in the bone used to secure the guide body, the spacing of the holes being such that the cut ends of the bone are brought into contact.

10. A surgical cutting guide substantially as herein described with reference to, and as

illustrated in, the accompanying drawings.

11. A surgical bone shortening apparatus comprising a cutting guide and a joining plate both substantially as herein described with reference to, and as illustrated in, the accompanying drawings.

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